Changes to RUSLE2 from the RUSLE2 ARS Version December 2, 2003 to the RUSLE2 ARS Version January 19, 2005

January 18, 2005

Changes that significantly affected computed erosion values

1. **Change**: Change in **core database** root biomass values for alfalfa (***note the change is in the input values, not in the program***)

   Nature of change: The USLE/RUSLE1 cover-management C factor value computed by the December 2, 2003 RUSLE2 ARS Version for established alfalfa with the December 2, 2003 **moses ARS** core database is 0.04. The corresponding value given in Agriculture Handbook 537 is 0.02, which is the value that RUSLE2 should compute. Thus, the C factor value for alfalfa computed with the December 2, 2003 moses ARS core database values were too high by a factor of 2, and consequently the erosion values computed by RUSLE2 for established alfalfa were too high by about a factor of 2. Also, the curve number and runoff values computed by RUSLE2 were high relative to the RUSLE2 values computed for continuous, conventionally tilled corn and relative to measured runoff reported in USDA technical bulletins. The values computed by all RUSLE2 cover-management subfactors were reviewed to determine where to make changes so that RUSLE2 would compute expected erosion and runoff for alfalfa. The most appropriate change was determined to be input values for effective root biomass. A procedure similar to that used to develop effective root biomass values for rangeland plant communities was used to develop effective root biomass values for alfalfa. The effective root biomass values required by RUSLE2 may not match field measured root biomass values. **Use the values given in the January 19, 2005 RUSLE2 core database regardless of measured root biomass values.** The effective root biomass for established alfalfa was changed from 3500 lbs/acre in the upper 4 inches in the **December 2, 2003 moses ARS core database** to 5300 lbs/acre in the upper 4 inches for 3rd year alfalfa in the **January 19, 2005 RUSLE2 core database**. Proportional changes were made for other years during alfalfa establishment. With these changes, the RUSLE2 January 19, 2005 ARS Version and RUSLE2 core database compute 0.016 for the USLE/RUSLE1 C factor value for established alfalfa.

   Impact of change: Erosion computed with the December 2, 2003 **moses ARS core database** is about twice that computed using the January 19, 2005 **RUSLE2 core database** for periods in a cover-management description when alfalfa is present. For example, RUSLE2 computed 16 tons/acre for a typical overland flow path in the La Crosse, WI area with the December 2, 2003 **moses ARS database** and 7.7 tons/acre with the January 19, 2005 **RUSLE2 core database**. Users should change the root biomass values for alfalfa and alfalfa mixtures in their **working** RUSLE2 databases to be consistent with the new values in the **January 19, 2005 RUSLE2 core database**. Previous RUSLE2 computations involving alfalfa should be redone because of major differences in computed erosion values.

2. **Change**: Corrected errors in computing deposition in channels

   Nature of change: RUSLE2 computed erroneous values for deposition and thus sediment yield for channels for overland flow path lengths other than about 125 to 175 ft.

   Impact of change: Any RUSLE2 computation of deposition and sediment yield for channels (e.g., terraces channels and furrows between ridges and beds) should be redone if overland flow path length is less than 125 ft and greater than 175 ft. A comparison of the computations between the December 2, 2003 and January 19, 2005 RUSLE2 ARS versions is shown in the table below. These computations were for the base profile that is 150 ft long, 6 percent steep, 112 bu/ac continuous, conventionally tilled moldboard corn at Columbia, MO. All computations made with the December 2, 2003 RUSLE2 ARS version involving deposition in channels should be redone.

Computation of sediment yield from a 0.2 percent grade channel						
	December 2, 2003 version			January 19, 2005 version		
Overland flow path length (ft)	Erosion on overland flow area (tons/acre)	Sediment yield tons/acre)	Sediment delivery ratio	Erosion on overland flow area (tons/acre)	Sediment yield tons/acre)	Sediment delivery ratio
200	14.3	2.69	0.19	14.2	3.97	0.28
150	12.6	3.20	0.25	12.5	3.35	0.27
100	10.6	4.45	0.42	10.5	2.71	0.26
50	7.80	5.92	0.76	7.76	2.05	0.26
30	6.24	6.10	0.98	6.22	1.76	0.28
10	4.62	4.62	1.00	4.60	1.48	0.32
2	4.61	4.61	1.00	4.59	1.39	0.30

3. **Change**: Computation of backwater added

   Nature of change: Equations were added to compute the width of the backwater created by high retardance porous barriers such as dense vegetation strips (e.g., grass buffer and filter strips and stiff grass hedges), fabric fences (e.g., silt fences), and gravel bag dams. The backwater width is added to high retardance strip width to create an effective width equal to the segment length of the high retardance material plus the backwater width. RUSLE2 computes a backwater for all retardance conditions, but the effect is most important for high retardance segments. A new retardance class of **extreme retardance** was created to represent fabric fences (e.g., silt fences),very dense narrow vegetation strips (e.g., stiff grass hedges), and other similarly behaving porous barriers. Use of this retardance class ensures that RUSLE2 will compute a minimum of 3 ft backwater width.

Impact of change: This backwater procedure, which was not in the December 2, 2003 RUSLE2 ARS version, is now the default procedure in the January 19, 2005 RUSLE2 ARS version. Users of the December 2, 2003 version were instructed to enter effective strip widths (segment lengths) to account for backwater width. RUSLE2 input values based on effective strip width to account for backwater should not be used in the January 19, 2005 RUSLE2 ARS version. If these input values are used, RUSLE2 computes too much deposition by narrow vegetation strips and fabric fences. New RUSLE2 input values should be prepared where narrow vegetation strip widths are assigned a 2 ft width, unless the actual strip width is greater than 2 ft. The width input for a fabric fence should be 1 ft. The special retardance class of **extreme retardance** should be used for these porous barriers including stiff grass hedges, fabric fences, and gravel bag dams. This change has little effect on computed erosion for vegetation strips (e.g., grass buffer and filter strips) wider than about 15 ft for most situations, and this change has litter effect on computed erosion for contour strip cropping. Previous computations for very dense narrow strips having a high retardance should be redone and new inputs entered in users' working databases.

4. **Change**: A zero row grade is assumed for porous barriers such as grass buffer and filter strips, stiff grass hedges, and fabric fences when selected from the menu of support practices and the profile row grade is up and down hill.

   Nature of change: The general RUSLE2 assumption is that porous barriers selected using the support practice description procedure are not effective when relative row grade exceeds 10 percent. This change accommodates the special case where runoff from an upslope area on an up and down hill row grade is intercepted by a porous barrier on a zero row grade.

   Impact of change: When the menu selection procedure for support practices is used to represent porous barriers, RUSLE2 uses a zero row grade to compute the effect of a porous barrier on erosion when the profile row grade is up and down hill. The December 2, 2003 RUSLE2 ARS version did not allow this computation. RUSLE2 adjusts for the effect of row grade on trapping effectiveness of barriers by assuming that runoff flows through the porous barrier regardless of row grade when the procedure of dividing the three layer schematic on the ARS complex slope templates is used to describe high retardance segments on an overland flow path. The RUSLE2 computed retardance is based on a non-linear interpolation of hydraulic roughness when rows of the vegetation are on the contour and the hydraulic roughness when the rows of vegetation are up and down hill. RUSLE2 will not allow an erosion computation if relative row grade exceeds 10 percent when the menu selection procedure for support practices is used. RUSLE2 computations should be redone for conditions where high retardance strips on the contour intercept runoff from an up and downhill row orientation.

5. **Change**: Corrected errors in erosion computations when the command to globally change units was used

   Nature of change: Changing units by using the globally change units command in the **Options** item on the RUSLE2 **menu bar** resulted in RUSLE2 giving very erroneous erosion estimates.

   Impact of change: Any soil erosion computations made with the December 2, 2003 RUSLE2 ARS version where the global change of units command in the Options menu bar item was used should be discarded and the computations redone.

6. **Change**: Corrected errors caused by change of units on **residue amount added/removed** variable in a cover-management description

   Nature of change: Using the right mouse click to change units when the cursor is placed on the variable name residue amount added/removed in a cover-management description variable produced erroneous RUSLE2 computed erosion values. One situation where the error occurred was when the units were changed and a new value for residue amount added/removed was entered after the units change to compute erosion values for a new residue amount.

   Impact of change: RUSLE2 correctly computed erosion with the ARS templates delivered with the December 2, 2003 RUSLE2 ARS version on the NSL RUSLE2 web site for the US customary units in the templates. However, RUSLE2 computed significantly erroneous erosion estimates when the right click method was used to change the units for residue amount added/removed to any other unit besides lbs/acre and a subsequent entry of residue amount and erosion computation was made. Such computations should be redone.

7. **Change**: Corrected RUSLE2 to properly computes erosion using SI customary units when the overland flow path is divided into segments

   Nature of change: The December 2, 2003 RUSLE2 ARS version using customary SI untis gave erroneous negative segment lengths when the overland flow path was divided into segments, which caused the program to “bomb.”

   Impact of change: The program now works properly when dividing the overland flow path into segment when SI customary SI units are used.

Changes that did not significantly affect computed erosion values

8. **Change:** Improved above ground biomass-canopy cover relationships

    Nature of change: Improved above ground biomass-canopy cover relationships in the January 19, 2005 RUSLE2 ARS version that describe vegetative growth phases of new growth, senescence, and regrowth replaced comparable relationships in the December 2, 2003 RUSLE2 ARS version. The new relationships improve consistency and continuity between these growth phases that did not exist in the previous relationships. The new relationships correctly accounted for above ground biomass between the last date that a current vegetation description is used and the value on day zero of the next vegetation description. The new relationships also properly describe canopy cover between the end of a live vegetation description like corn where canopy decreased without a change in above ground biomass and canopy cover on the date that the live vegetation becomes standing residue. The overall representation of above ground biomass-canopy cover for both live vegetation and standing residue was significantly improved. The basic relationship of canopy cover to above ground biomass was the same in new relationships

    Impact of change: The change has little effect on computed average annual erosion. Graphs of daily canopy cover and above ground biomass must be examined to detect the change in most cases. No repeat of previous computations should be necessary.

9. **Change:** Long term soil surface roughness was made a function of soil texture and soil biomass

    Nature of change: Long term soil surface roughness was made a function of the same soil texture and soil biomass variables as initial soil surface roughness. This change makes long term roughness a function of the major variables that affect long term roughness. This change provides consistency in erosion estimates as a function of roughness for temporary left by mechanical soil disturbance and the long term roughness that naturally evolves over time.

    Impact of change: This change affected computed annual erosion for permanent vegetation and for long duration no-rotation cover-management descriptions. The change in computed erosion is minor, but sufficient to warrant users making RUSLE2 computations to determine the extent of the change for your particular situation. For example, erosion changed from 2.9 to 3.2 tons/acre for a southern range grass for Brazos County, Texas from the December 2, 2003 RUSLE2 ARS version to January 19, 2005 RUSLE2 ARS version. The RUSLE2 User’s Reference Guide will be revised to include new core values for long term roughness to replace current values. This update should be completed in the RUSLE2 User’s Reference Guide by July 1, 2005. Long term roughness values in the January 19, 2005 RUSLE2 core database have not been updated to reflect this change.

10. **Change:** Corrected units in table heading in soil description for fall velocity

    Nature of change: The heading for fall velocity in the soil description in the December 2, 2003 RUSLE2 ARS version was incorrect. The displayed fall velocity values were actually in ft/sec units but the table heading was m/s. The values displayed when the column heading was in ft/sec were incorrect in the December 2, 2003 RUSLE2 ARS version.

    Impact of change: The correction of the table heading did not affect computed erosion and deposition values. The error had impact only if fall velocity values displayed by RUSLE2 were used outside of RUSLE2 or fall velocity values from outside of RUSLE2 were entered in a RUSLE2 soil description. RUSLE2 calculated and used the correct fall velocity values in its internal computations.

11. **Change:** Corrected computation of the variable **pmbase** in the contouring equations

    Nature of change: An incorrect slope steepness variable was used to compute pmbase in the contouring computations.

    Impact of change: This has only a slight effect on computed erosion. For example, the computed erosion is 8.8 tons/ac with both versions with perfect contouring for the base Columbia, MO profile for conventionally tilled, continuous 112 bu/ac corn on a 150 ft long, 6 percent steep overland flow path. The comparable values are 26 tons/acre computed by the December 2, 2003 version and 27 tons/ac computed by the January 19, 2005 version for a 12 percent steep overland flow path. The effect of the change does not seem to warrant re-computing erosion values for most situations where contouring was involved.

12. **Change:** Improved root biomass distribution equations to eliminate discontinuity

    Nature of change: The root biomass distribution involves separate equations for an upper and lower depth. The equations had a slight discontinuity in the December 2, 2003 version that was corrected in the January 19, 2005 version.

    Impact of change: Total root biomass values were unchanged. The change in distribution of root biomass values by depth was below primary tillage depth for most agricultural crops and usually below the upper 10-inch depth used in RUSLE2 to compute root biomass density used to compute values for the soil biomass subfactor. The change in computed erosion values would hardly be noticeable and only then where very deep tillage is involved. The only way the change can be seen is when the root biomass values are plotted with depth. The difference is seen in the continuity of root biomass values with depth in the January 19, 2005 version in contrast to a discontinuity in the values for the December 2, 2003 RUSLE2 ARWS version.

13. **Change:** Removed a row grade effect in the computing of effective vegetation ridge height

    Nature of change: The equations used in the December 2, 2003 version involved a double counting of row grade on the effect of vegetation ridge height.

    Impact of change: The December 2, 2003 RUSLE2 ARS version computes an effective vegetation ridge height of 0.85 inches for a conventionally tilled 45 bu/ac winter wheat grown on the base Columbia, Missouri profile for a 10 percent row grade on a 6 percent steep overland flow path while the comparable value is 1.3 inches computed by the January 19, 2005 RUSLE2 ARS version. Both versions compute 9.7 tons/ac erosion for row grade up and down hill. The December 2, 2003 RUSLE2 ARS version computes an erosion value of 6.3 tons/ac for a 10 percent row grade while the January 19, 2005 version computes 5.9 tons/ac. The difference in erosion estimates between the versions increases as crop yield increases. The January 19, 2005 version computes slightly less erosion as a function of the effective vegetation ridge height, which is considered to be an improved result. Users should compare computed erosion between the two versions to determine if re-computing erosion is needed. The change in computed erosion for this change is not considered to be significant for most situations. A guideline used during the development of RUSLE2 is that erosion values needed to change by more than 10 percent for the change to be considered significant.

14. **Change:** Corrected errors in long-term vegetation computations

    Nature of change: Corrected computations that resulted in errors for data points at the very end of the annual period and timing of values during the annual period.

    Impact of change: The effects on computed erosion are very slight. The errors were only apparent when temporal values for the vegetation description were plotted. The changes in computed erosion values are so slight that no previous RUSLE2 computations need to be redone.